

Dutch Elm Disease

A non-native invasive wilt

Pathogen—The fungus *Ophiostoma novo-ulmi* is the most aggressive pathogen involved, but other *Ophiostoma* species may occur within the Rocky Mountain Region. The pathogen was introduced into the United States in the 1930s and subsequently spread throughout the country.

Vectors—The native elm bark beetle (*Hylurgopinus rufipes*), smaller European elm bark beetle (*Scolytus multistriatus*), and potentially the banded elm bark beetle (*S. schevyrewi*) vector the pathogen. See the Elm Bark Beetles entry in this guide for more information.

Hosts—This disease affects trees in the elm family (Ulmaceae). Native elms are most susceptible.

Signs and Symptoms—Symptoms differ between trees that are infected through root grafts and those infected via beetles. Trees infected by root grafts wilt, their leaves turn brown, and the trees die rapidly, usually in the spring (fig. 1). When the disease is transmitted by bark beetles, the first symptoms are often yellowing and wilting of leaves on one or several branches. The leaves eventually turn brown and fall in mid to late summer (figs. 2-3). As the disease spreads to adjacent branches, additional branches die, and eventually tree mortality results. This often takes 1 or more years.

Slight symptom differences also occur among the beetle vectors. The smaller European elm bark beetle feeds in small twigs, usually high in the crown of mature trees. This results in the initial wilt symptoms on higher and smaller branches. In contrast, the native elm bark beetle bores into the bark of branches 2-4 inches (5-10 cm) in diameter to feed.

Brown streaks in the new sapwood are characteristic symptoms of infection (fig. 4). However, laboratory tests may be needed to confirm the presence of the pathogen because signs of the pathogen are usually microscopic. Sometimes the white spore-bearing bodies with tiny black stalks (synnemata, also known as coremia) of *Ophiostoma* may be visible in beetle galleries (fig. 5).

Disease Cycle—The pathogen infects new trees when the bark beetle vectors feed on twigs or small branches of healthy trees; new trees are also infected throughout the growing season by root grafts. As the beetles feed, they introduce the pathogen spores attached to their body into the sapwood. The fungus quickly spreads in the vessels of the xylem and moves both up and, more importantly, down, eventually reaching the roots. As the disease spreads throughout the tree, it disrupts water movement, causing trees to wilt. The fungus continues moving through the root system, infecting other adjacent trees through root grafts. As trees die, the beetles form breeding galleries in the recently dead or dying stems



Figure 1. Trees killed by Dutch elm disease that spread through root grafts. Photo: Edward L. Barnard, Florida Department of Agriculture and Consumer Services, Bugwood.org.



Figure 2. Typical crown symptoms of Dutch elm disease associated with insect transmission. Photo: Northeastern Area Archive, USDA Forest Service, Bugwood.org.



Figure 3. Close-up with yellow and brown leaves due to Dutch elm disease. Photo: Joseph O'Brien, USDA Forest Service, Bugwood.org.

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and branches of infected trees. The fungus sporulates in the galleries, and spores are picked up by the beetles in the galleries and are carried to a new, healthy host.

Impact—Since its introduction in the 1930s, this disease has quickly spread throughout the range of elms and is now the most damaging disease of elm and the leading cause of elm mortality.

Management—Sanitation (removal of infected materials) can significantly reduce the disease spread of new infections. Sanitation efforts should focus on promptly removing infected trees and prohibiting the storage of elm wood with attached bark because beetles can infest cut wood and spread the disease. The fungus can persist in the sapwood for several years after trees die.

Breaking root grafts is important to prevent root spread but may be difficult and expensive. Root graft disruption should be done before the infected trees are removed. Otherwise, the transpirational pull from the healthy trees will draw the pathogen from the diseased tree roots to the healthy tree.

A few varieties of American elm with some level of resistance are commercially available. However, many of the resistant elm varieties are susceptible to elm yellows. Planting resistant European or Asiatic elm species will reduce losses, but the growth forms are not the same as the American elm. Non-elm species adapted to the area are another option.

Preventive chemicals are available as tree injections that can protect healthy elms from the disease for up to 3 years. Because the chemicals are injected in the lower stems or upper roots and can only move upward in trees, these treatments are ineffective for root-graft infections. The treatments are also costly but might be appropriate for high-value trees. An appropriately registered fungicide for an individual state should be selected.



Figure 4. Brown streaks in the new sapwood caused by *Ophiostoma novo-ulmi*. Photo: Petr Kapitola, State Phytosanitary Administration, Bugwood.org.



Figure 5. The pathogen *Ophiostoma novo-ulmi* sporulating along beetle gallery. Photo: Joseph O'Brien, USDA Forest Service, Bugwood.org.

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